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Genotyping of *Echinococcus granulosus* from domestic animals and humans from Ardabil Province, northwest Iran

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Abstract

Cystic echinococcosis is endemic in Iran, particularly in Ardabil Province, where it causes health and economic problems. The genetic pattern of *Echinococcus granulosus* has been determined in most parts of Iran, except in this area. In the present investigation, 55 larval isolates were collected from humans (11), sheep (19), goats (4) and cattle (21). For analysis of the genetic characteristics of *E. granulosus* isolates, DNA sequencing of mitochondrial cytochrome *c* oxidase subunit 1 (*cox*1) and NADH dehydrogenase subunit 1 (*nad*1) genes was applied. Fifty isolates were successfully analysed, with 92% (46) and 8% (4) identified as G1 and G3 genotypes, respectively. The sequence analyses of the isolates displayed nine characteristic profiles in *cox*1 sequences and eight characteristic profiles in *nad*1 sequences. Based on these results, the sheep strain (G1 genotype) was the most prevalent in humans, sheep, goats and cattle. The buffalo strain (G3 genotype) was not only demonstrated in sheep (1 isolate) and cattle (1 isolate), but also for the first time in two human isolates. These findings will provide information for local control of echinococcosis.

Introduction

The *Echinococcus granulosus* metacestode, the aetiological agent of cystic echinococcosis, is an important medical, veterinary and economic problem worldwide (Thompson, 2008). During the past 40 years, several variants have been described within the species (Thompson & McManus, 2002). Recognition of these strains and genoypes is important for the formulation and development of vaccines, diagnosis, epidemiology, therapeutics and prevention and control of hydatid disease (McManus & Thompson, 2003).

Investigations using mitochondrial DNA (mtDNA) sequences have characterized ten genotypes (G1–G10) within *E. granulosus sensu lato* (Scott *et al.*, 1997; Lavikainen *et al.*, 2003). These comprise two sheep strains (G1 and G2), two bovid strains (G3 and G5), a horse strain (G4), a camel strain (G6), two pig strains (G7 and G9) and cervid strains (G8 and G10) (McManus & Thompson, 2003; Lavikainen *et al.*, 2006). Since the taxon *E. granulosus sensu lato* is paraphyletic (Moro & Schantz, 2009), a

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